ISSUES, IDEAS AND INFORMATION FOR PSYCHOLOGY STUDENTS

NO.1 - ENVIRONMENTAL PSYCHOLOGY

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CONTENTS

Kevin Brewer; 2009; ISBN: 978-1-904542-39-1

1. STUDYING THE EFFECTS OF NOISE - QUASI-EXPERIMENTAL NATURALISTIC STUDIES VS LABORATORY EXPERIMENTS

1.1. QUASI-EXPERIMENTAL DESIGN AND NOISE

Cook and Campbell (1979) defined quasi-experiments as "experiments that have treatments, outcome measures, and experimental units, but do not use random assignment to create the comparisons from which treatment-caused change is inferred".

Many pieces of research are classed as experiments when in fact they are quasi-experiments. This is important because the experiment is the only method by which causation can be established. Quasi-experiments do not have the randomisation of participants or the clear control of variables found in "true" experiments. However they do have their uses (table 1.1).

ADVANTAGES	DISADVANTAGES
1. As close as possible to experimental design. 2. Useful where not possible to do experiment; eg: due to ethical concerns. 3. Take the opportunity to study events that are occurring in real life. 4. Give clues to cause and effect. 5. Used where impossible to study	1. Not an experiment, so caution about claiming causality. 2. Questions about generalisability of findings. 3. Independent variable is not manipulated technically. 4. No random allocation of participants to groups. 5. Usually not replicable, particularly if based around natural event.

Table 1.1 - Advantages and disadvantages of quasi-experiments.

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1.2. NOISE

Exposure to noise [1] has an affect upon individuals, particularly when it is loud noise (65 decibels or above). The consequences of the exposure include annoyance, sleep disturbance, cognitive impairment, and physiological changes.

The focus is upon non-auditory effects of noise, defined as "all those effects on health and well-being which are caused by exposure to noise, with the exclusion of effects on the hearing organ and the effects which are due to the masking of auditory information (ie: communication problems)" (Smith and Broadbent 1992 quoted in Stansfeld and Matheson 2003 p243).

Noise has many non-auditory effects (table 1.2). Stansfeld and Matheson (2003) concluded that the "evidence for effects of environmental noise on health is strongest for annoyance, sleep and cognitive performance in adults and children".

EFFECTS
• Sleep disturbance and aircraft noise
• Reduced memory with speech noise
• After-effects of noise and reduced performance on tests
• Physiological changes: increased heart rate and blood pressure
• Increased psychological symptoms; eg: "headaches", "being tense and edgy"
• Children - attention deficits; poorer reading ability

Table 1.2 - Key effects of environmental noise (Stansfeld and Matheson 2003).

Cohen and Spacapan (1984) noted variables that influenced the effect of noise:

- Intrusiveness (or perceived intrusiveness) produces increased annoyance and physiological responses;
- Predictability reduces the stressful effect of noise;
- Perceived lack of control of noise exacerbates the effect;
- Attribution of cause of the sound. Annoyance is heightened by factors like the noise perceived as unnecessary, and those responsible for the noise perceived as unconcerned about others.

[1] Defined as "undesirable noise" (Haralabidis et al 2008).

Kevin Brewer; 2009; ISBN: 978-1-904542-39-1

1.3. CHILDREN AND ENVIRONMENTAL NOISE

1.3.1. Aircraft Noise

In Japan Ando et al (1975) tested 9-10 year-olds with a thirty-five minute attention-demanding adding task. The children were from schools near Osaka International Airport or a quiet part of Kawanishi City, and were studied in a noisy condition (90 dBA background noise recording) and in silence (figure 1.1). This produced four study groups in a cross-over design (ie: related design).

SCHOOL	ENVIRONMENTAL
noise	quiet
noise	noise
quiet	noise
quiet	quiet

Figure 1.1 - Four study conditions in Ando et al (1975).

The noisy school/noisy experiment contained the most children with poor performance on the adding task (over 50%). Children from quiet schools while in the noisy experiment were poorer than in the quiet experiment. Ando et al coined the term "V-type relaxed" to describe the sudden deterioration in attention during the task.

The Los Angeles Noise Project was set up to study the long-term impact of aircraft noise on young school children living and attending school in the flightpath, and comparing with a matched group in quiet neighbourhoods. Cohen et al (1980) showed that children from noisy schools had higher blood pressure, were more likely to fail on cognitive tests, were more likely to "give up" before completing the task, and were more distractible than children from quiet schools. The longer the children had lived in the area, the stronger the effects.

Cohen et al (1980) then chose twenty children in the noise sample living in the quietest homes (in relation to aircraft noise). Their results were compared to the other children. Living in a quiet home did not lessen the negative effects of a noisy school environment.

After the research, schools under the flightpath were compensated by the airport authorities in order to adapt the classrooms to reduce noise levels.

Cohen et al (1981) continued the study aiming to see

Kevin Brewer; 2009; ISBN: 978-1-904542-39-1

the longer term impact of noise, and if noise abatement interventions had helped. The participants were children from the four noisiest elementary schools in the flightpath of Los Angeles International Airport and three quiet schools (as matched by social class, ethnicity, and age). The noisy schools experienced over 300 flights a day (ie: every 2.5 minutes) up to 95 dBA [2] each time.

The children were tested in a noise-insulated mobile laboratory in spring 1977 and one year later. The measures included:

- Blood pressure;
- Helplessness - whether the child gave up in solving a nine-piece puzzle within four minutes after experiencing an unsolvable puzzle for 2.5 minutes;
- Distractibility - the children crossed out the letter "e" in a two-page booklet while a taped voice was played over headphones;
- School achievement.

In spring 1977 262 children were tested (142 noise and 120 quiet), and 163 were retested in 1978 (83 noise and 80 quiet)(62% of the total original sample; 67% quiet and 58% noise).

The children at noisy schools had higher blood pressure. Distractibility and noise showed a relationship based on length of time at school. Children enrolled for 2-3 years at noisy school found more letter "e"s than quiet schools, but it was the opposite for children in schools four years or more. In the shorter term, children living with environmental noise are less distracted by noise. This study confirmed the findings from Cohen et al (1980) that children from noisy schools suffered from the effects of noise, and did not adapt to it over a long period of time.

The children in noise abatement classrooms showed small benefits in, for example, reduced blood pressure, but the noise level was still higher than quiet schools. Means of 79.06 dBA for noisy classrooms, 63.17 dBA for abated, and 56.60 dBA for quiet ones.

Haines et al (2001b) examined the cognitive performance and health of children living around London Heathrow airport. Children aged 8-11 attending four schools with high aircraft noise (>66 dBA)(n = 340) and four matched control schools (<57 dBA)(n = 275) were tested in 1996 (Haines et al 2001a) and then one year later. Matching was based upon age, sex, sound level at the school from non-aircraft sources, existing noise

[2] dBA = "measure of sound level in decibels A-weighted to approximate the typical sensitivity of the human ear" (Clark et al 2006).

protection in schools, and socioeconomic status and ethnicity of school's electoral wards.

Table 1.3 summarises the main measures of behaviour and the findings on them.

MEASURE OF BEHAVIOUR	FINDINGS ABOUT NOISY SCHOOLS
Noise annoyance - 7 questions and 4-point Likert	Significantly greater annoyance about aircraft noise
Stress - Lewis Child Stress Scale (Lewis	Significantly greater perceived stress, but no difference in
Depression and anxiety*	No differences
Reading comprehension*	Significantly poorer; became worse with increased experimental
Sustained attention	Significantly poorer

(* = standardised measures used)

Table 1.3 - Measures of behaviour and findings from Haines et al (2001b).

1.3.2. Railway Traffic Noise

In terms of this type of noise, Hambrick-Dixon (1986) studied five year-olds attending day care centres either near to or far from elevated subways under quiet or noisy laboratory conditions. In one intelligence test, children from noisy day care centres tested under noisy conditions did the best of all groups. This test involved matching the correct coloured disk with it paired picture fifteen times in two minutes. Children from quiet day care centres performed better in silent laboratory conditions. However, on all other tests all the children did poorer under noisy laboratory conditions.

1.3.3. Road Traffic Noise

Children's attention and concentration have been tested in various ways. Muller et al (1998) used the following tests when examining the effects of road traffic noise:

- Inspecting text for a certain letter and mark it every time it appears within a limited time. An accuracy score is calculated of correct minus incorrect items.
- A Stroop test where the children responded if the word matched the colour written in or not for five minutes (eg: "RED" written in red ink). Reaction time was the

measure here.
- A visual vigilance task which involved children watching a cursor moving on a screen, and their reaction time to respond when it moved irregularly was measured.

Nine year-olds from noisy environments were less accurate on the first test (requiring sustained attention) in noisy laboratory conditions, but had faster reaction times on the other two tests.

1.3.4. Combinations of Noises

The RANCH (Road traffic and Aircraft Noise exposure and Children's cognitive and Health) project (Stansfeld et al 2005) explored the effects of two different noises with over 2000 9-10 year-olds living near airports in Amsterdam, Madrid and London.

Clark et al (2006) divided the children based on aircraft and road traffic noise into both types, one but not the other, and neither. Reading comprehension was measured in classrooms using standardised tests in each language.

Increasing aircraft noise at school was significantly related to poorer reading comprehension scores when the data were pooled from three countries. For example, calculations showed a decrement of eight months (1/8 standard deviation) in reading age in the UK due to 20 dBA increase in aircraft noise. Chronic road traffic noise at school had no significant effect on reading comprehension.

The authors asked and answered their own question:

> Why should there be an effect for aircraft but not road traffic noise? Aircraft noise is more intense and less predictable than road traffic noise. The transient nature of aircraft flyovers, which have high short-term noise level, may disrupt children's concentration and distract them from learning tasks, while the constant nature of road traffic noise may allow children to habituate and not be distracted (Clark et al 2006).

This study has a number of strengths and weaknesses (table 1.4).

STRENGTHS

1. Examined the effects of two types of noise (aircraft and road

traffic).

2. Comparison of children near airports in three different countries in Western Europe.

3. Matching of schools in each country based on socioeconomic status and ethnicity.

4. The schools were visited and noise surveys made inside and outside the classrooms. They were then categorised from low to high for each noise to produce sixteen groups.

5. From each noise category, two schools were selected, and within each school mixed-ability, mixed-sex classes were sampled.

6. Reading comprehension was measured using nationally standardised tests for each country. The z scores [3] were computed for each test which allowed comparison.

7. Questionnaires completed by the children and a parent highlighted potential confounding variables; eg: parental support for schoolwork.

8. It was a large scale study with 2010 children out of 2844 approached (88% response rate) from 89 schools.

9. Written consent was obtained from both parents and children, and local ethical approval bodies.

10. It was the first study to show a linear relationship between increasing aircraft noise and an increased effect on reading comprehension.

WEAKNESSES

1. This was a quasi-experimental design. It was a pseudo-experiment with a "quasi-independent variable" (Leary 2001). This means that the researchers did not manipulate the independent variable (noise levels) technically.

2. It was also a quasi-experimentally design because there was no random allocation of the participants. The participants were placed in the groups based on which school they attended in terms of noise.

3. The noise data were calculated, and not measured for the 24-hour period. Aircraft noise exposure was estimated for 16 hours (7am-11pm) based on details of flight timetables, and noise measurements taken at the schools.

4. There was no significant relationship between road traffic noise and reading comprehension. This could have been due to underestimates of traffic noise, and/or distance from classrooms from the road. Road traffic noise was calculated based on proximity of school to major roads and noise measurements at front of the school.

5. Reading measures were not exactly equivalent across the three countries.

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[3] Z scores convert raw scores into standard scores based on the mean and standard deviation of the group.

6. Testing of the children lasted two hours, which is a long time for the children to concentrate.

7. The groups were not equal sized from each country: Netherlands = 583, Spain = 572, and UK = 855.

8. Mean aircraft noise exposure was lower in Spain (43 dBA vs 54 dBA in the Netherlands and 52 dBA in the UK), but road traffic noise was similar (around 50 dBA).

9. 53% of the total sample was female.

10. Unlike a laboratory experiment, the researchers could not control the overall amount of noise experienced by the children at school, but also outside school. The focus was also only upon noise at school not at home (Stansfeld et al 2005).

Table 1.4 - Strengths and weaknesses of Clark et al (2006) study.

The effects of both road and railway traffic noise on young children's memory was examined in Austria as "Tyrol school study II" (Meis et al 1999 reported in Meis 2000). 123 pupils (average age 9.7 years) from noisy and quiet environments had their recall for a story about an accident tested in silence or against the background of road and rail traffic noise in the mobile laboratory.

The children performed best under congruent environmental conditions. Those from noisy environments recalled more (over 35% correct) with less errors (35%) in the noisy laboratory conditions, and children from quiet environments in quiet laboratory conditions (over 40% correct and less than 30% errors).

Meis (2000) proposed the "environmental stimulation congruence" hypothesis to explain the findings. Cognitive performance is established and maintained in a prevailing noise environment. Changing the noise environment reduces cognitive performance whether it be from quiet to noisy or vice versa. If this is so, there is an implication for pupils who study and live with high levels of self-selected noise in everyday life (eg: music, television) when it comes to the silence of an examination room.

1.4. NATURAL EXPERIMENT: CHILDREN'S COGNITIVE PERFORMANCE

Hygge et al (2002) [4] used the opportunity of the simultaneous opening of a new airport and the closing of the old one in Munich, Germany [5] to study the effects of

[4] This study is part of the Munich Airport Noise Study (Hygge et al 1996).

[5] In May 1992 the old airport (Muenchen-Riem) closed and the new one opened (Franz-Josef Strauss Flughafen)(Meis 2000).

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noise levels on children's cognitive performance.

The researchers recruited 326 children aged between 8-12 years and matched for sociodemographic characteristics (eg: ethnicity, number of family members, parental occupation and education). The children were divided into four groups (two experimental, two control):

- Old airport noise (n = 65)(experimental group 1) - children living near to old Munich airport;
- Old airport no noise (n = 43)(control group 1) - children living near old airport, but noise levels low;
- New airport noise (n = 111)(experimental group 2) - children living near to new Munich airport;
- New airport no noise (n = 107)(control group 2) - children living new airport, but noise levels low.

Data were collected at three points in time - six months prior to changeover of airports, one year and two years after the changeover (table 1.5).

	Experimental group 1 - old	Experimental group 2 - new	Control groups
Point 1 - prior to changeover	High noise (average 68	Low noise (53 dBA)	Low noise (59 and 53 dBA)
Points 2/3 - after	Low noise (54 dBA)	High noise (62 dBA)	Low noise (55 dBA)
Focus	Effect of reduction in	Effect of increase in	No change in noise level

(* = Noise levels over 24 hour period)

Table 1.5 - Design of study by Hygge et al (2002).

The dependent variable was measured by an array of individual cognitive tests. The researchers visited the children's schools for data collection, which lasted 1.5 hours, in a specially designed temperature-controlled and sound-attenuated mobile laboratory. The cognitive tests included:

i) Reading - standardised German reading test where children read paragraphs and word lists, including some pseudowords, of increasing difficulty;

ii) Memory - 24 hour recall in silence of text read with noise in headphones (50 dBA)(long-term memory), and immediate recall of consonants (short-term memory);

iii) Attention - measured by finding target figures embedded in complex figures (visual search task), and reaction time response to different lights flashing. The task were performed in silence and with noise (equivalent to an aircraft);

iv) Speech perception - children listened to a story against background noise, and lowest level of hearing is measured for understanding the story.

The main patterns of results were as follows:

a) Reading - all groups produced less mean errors with each data collection point, which was probably due to practice with the tests, and/or improved reading with age. There was over two years between the first and third data collection.

The old airport noise group made significantly more errors than their control group when the airport was open, but this difference was gone by data collection point 3. In other words, their performance had improved (ie: a reverse of the effects of noise). The new airport noise group were showing more errors than their control group two years after the new airport had opened.

b) Memory - long-term memory was significantly poorer in the old airport noise group than their control group at data collection point 1, but no difference by point 3. the new airport noise group showed a decline in performance by point 3 compared to their control group. Short-term memory only showed a significant difference in the old airport noise group.

c) Attention - no differences in the embedded figures test, and some small differences in reaction time between the groups.

d) Speech perception - the new aircraft noise group showed problems after the airport opened, and the old airport noise group showed improvements after the airport closed, but not in comparison to their control group.

Table 1.6 summarises the results. Overall, the old airport noise group showed improvements in cognitive performance after the closure of the airport and noise levels dropped, and the new airport noise group showed declines as noise levels rose with the opening of the new airport. The effects were strongest for reading and long-term memory.

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Tests	Old airport noise group	New airport noise
Reading: Point 1	Significantly greater errors	No difference
Memory: Point 1	Significantly poorer long-term and short-term memory	No difference
Point 3	No difference	Significantly poorer long-term, no difference for short-
Attention	No real differences between groups or over	No real differences between groups or
Speech	Improvements after	Decline after airport

Table 1.6 - Summary of findings from Hugge et al (2002).

Hygge et al (2002) can be seen as an example of a natural experiment. Here the investigator observes the consequences of some natural event on individual's behaviour. There may be a control group, but the researcher did not or could not manipulate the independent variable.

Raulin and Graziano (1995) argued that natural experiments are strong quasi-experimental designs, such that the researcher "would feel justified in drawing rather strong causal conclusions".

Table 1.7 lists the evaluations of the methodology as used by Hygge et al (2002).

Evaluations

1. Able to study the effects of a unique event - the change of location of the Munich airport. But any findings cannot be replicated because this event is unlikely to happen again soon.

2. Any laboratory-based experimental versions of the research would be so limited compared to real-life.

3. Able to get baseline measures at point 1 before the event occurred.

4. Each of the two experimental groups had their own control or comparison groups. But this is not an experiment because the independent variable was not manipulated by the researchers, and there was no random allocation of participants to the groups.

5. The researchers were able to see the effect of aircraft noise in two directions - being reduced and being increased.

6. Combined both cross-sectional and longitudinal designs. But testing the children three times meant that their performance could have improved simply from familiarity with the tests (known as order effects in the repeated measures experimental design).

7. Standardisation of testing procedure in the mobile laboratory. But testing took 1.5 hours on two consecutive days each time, which is a long time for schoolchildren.

8. The collection of prospective data avoided any problems associated with retrospective data, like recall problems.

9. Use of standard tests for measuring cognitive abilities, and audiometric screening for normal hearing.

10. A large sample of Munich schoolchildren were used (n = 326), but not even numbers in each group. However, the groups did not differ in terms of sociodemographic characteristics.

11. Ethical issues related to the use of loud noise in the headphones during testing; eg: 5 minutes at 85 dB.

12. Problems of confounding variables; eg: apparatus failure on the speech perception task at data collection point 2 meant any data were discarded here.

13. It was "the first study to show prospective impacts of chronic noise on a cognitive process, long-term memory" (p473). But more research needed to establish the effect of duration of exposure to noise and children's age on long-term memory, and cognitive development.

14. Controlled noise levels were used in the mobile laboratory, but not a variety of levels (ie: only similar to aircraft noise).

Table 1.7 - Points of evaluation of Hygge et al (2002) study.

Meis (2000) used the Munich Airport Noise Study data to establish if memory (both implicit and explicit) was affected by the noise.

Implicit memory is where individuals recall information without conscious recollection of learning. It is tested experimentally by word stems and priming. Individuals are shown a list of words to remember, like types of clothes. Then they are presented with word stems to complete; for example, SK_ _ _. If participants write "skirt" it is seen as implicit memory as opposed to "skate".

Meis (2000) tested 218 children with an average age of 12 years. The children were instructed to read a list of 20 items (eg: parts of the human body) and rate how much they liked each word either with 80 dBA noise or silence over headphones. After five minutes, the children were asked to write down examples of different categories (implicit memory test), and free and cued recall of the

original list (explicit memory tests). Implicit memory was unaffected by noise in the laboratory, but children from quiet areas did better overall.

In the explicit memory test, children from quiet areas cued recalled 33% correct in the quiet laboratory condition and only 25% in the noisy laboratory. The children from noisy areas cued recalled about 25% in both laboratory conditions, but had better free recall in a noisy laboratory environment. There were also differences in the number of errors (ie: words recalled that not on original list)(table 1.8).

	QUIET LABORATORY	NOISY LABORATORY
LIVING NEAR AIRPORT		
Free recall	18.17	20.00
Free recall errors	34.58	33.81
Cued recall	25.50	23.70
LIVING IN QUIET AREAS		
Free recall	23.06	20.46
Free recall errors	17.82	28.31
Cued recall	32.90	25.17
Cued recall errors	23.71	40.89

Table 1.8 - Mean percentage of correct words recalled and percentage of errors made.

1.5. NOISE AND SLEEP

High levels of noise produce physiological changes, like a rise in blood pressure, during and after the noise (even for a few hours later; eg: Chang et al 2003). The effects of noise can also continue during sleep.

Noise disturbs sleep if there are more than fifty noise events per night with a maximum level of 50 dBA or more (Stansfeld and Matheson 2003).

This has been tested in sleep laboratories with controlled amounts and kinds of recorded noises (eg: Carter et al 2002). Haralabidis et al (2002) tested the physiological effects of noise during sleep in individuals living near four European airports as part of the HYENA (hypertension and exposure to noise during airports) project (Jarup et al 2005).

A total of 4861 individuals (2404 males and 2457 females) between 45 and 70 years old living near Athens (Greece), Malpensa (Milan, Italy), Arlanda (Stockholm, Sweden), and London Heathrow (England) airports were part of the HYENA project. Haralabidis et al concentrated upon a sample of 140 (43 from Greece, 16 England, 50 Italy, and 31 from Sweden). Twenty-one other participants were excluded for various reasons including using anti-

hypertension medication, using sleeping pills or sedatives, or regular use of earplugs.

Participants slept in their own bedrooms while blood pressure and heart rate were measured with a non-invasive device every fifteen minutes, and noise levels were recorded at similar intervals for the one night of the study.

An increase in blood pressure and heart rate was observed in the 15-minute intervals in which aircraft events occurred as well as with traffic or indoor event noises. Individuals had not habituated to common night-time noises.

This study is a quasi-experimental design which is called a "one group pre-test post-test design" (Singleton and Straits 1999)(figure 1.2). Though four sites were used, they are classed as one group because the same variables were being measured, and though multiple measures were taken during the night, it was one event that was being studied.

Pre-test: BASELINE MEASURE OF BLOOD PRESSURE (over daytime)
↓
EVENT (noises: aircraft, traffic, indoor)
↓
Poat-test: MEASUREMENT OF BLOOD PRESSURE (during night/after noise)

Figure 1.2 - One group pre-test post-test design of Haralabidis et al (2008).

Table 1.9 compares the strengths of this real-life study of noise and sleep with laboratory experiments of the same thing.

HARALABIDIS ET AL (2008)

1. Real-life events and noise being tested - aircraft, traffic and indoor noises (eg: snoring).

2. Individuals in their own bedrooms, so sleep not too disrupted by wearing blood pressure inflated cuff on the arm.

3. High quality equipment used to measure noise levels during the night, and to calculate level.

4. Able to compare effects of different types of naturally occurring noises. Laboratory experiments tend to concentrate upon one type of noise to avoid confounding variables.

5. Comparison of four airports in different countries. Laboratory experiments are restricted to one place and local participants available there.

6. Less concern about participant reactivity. Though individuals knew they were being studied, it was less effecting than sleeping in a laboratory environment.

OVERALL - Real-life events not easy to study in laboratory.

SLEEP LABORATORY EXPERIMENTS

1. "True" experiments with random allocation of participants and control over variables allow cause and effect to be established.

2. More complex equipment can be used which also measures, for example, EEG.

3. Able to control amount, level and consistency of noise. Haralabidis et al depended upon the number of aircraft events on night of study, which varied between the study sites (eg: more in Athens).

4. Often study individuals for more than one night as it takes time to adjust to sleeping in a sleep laboratory (eg: Ohrstrom 1989; studied participants for fourteen nights). Haralabidis et al only studied one night.

5. Participants constantly monitored. Haralabidis et al used specially trained nurses to visit participants three hours before sleep, but they did not stay after giving instructions and setting up the equipment.

6. Able to measure continuously. Haralabidis et al had to sample every fifteen minutes which "might have led to the 'loss' of the effect .. if the noise event happened to occur during the first minutes of intervals between measurements and the effect was of short duration" (Haralabidis et al 2008 p5).

OVERALL - Control of variables, participants, and environment.

BOTH TYPES OF METHODOLOGY

1. Physiological measures of blood pressure and heart rate.

2. Clear inclusion and exclusion criteria for participants.

3. Findings from Haralabidis et al were consistent with laboratory studies like Carter et al (2002): noise during sleep produced similar increases in blood pressure.

Table 1.9 - Strengths of studying noise and sleep using different methods.

Carter et al (2002) performed a laboratory experiment on the effects of noise during sleep with nine healthy female nurse volunteers on permanent night duty at Royal North Shore Hospital, Sydney, Australia.

After familiarisation with sleeping in the laboratory conditions, an 80-minute period was used for testing. Divided into 10-minute intervals, silence was alternated with the noise of truck passbys, civilian aircraft landings, military aircraft flyovers or tones all at 55, 65 or 75 dBA in a random order. The individual noises only lasted for a few seconds.

Two loudspeakers were placed on the ceiling in

opposite corners of the sleep room for aircraft noise, and two loudspeakers two metres from the bed on the floor for truck noise and the tones. Heart rate, blood pressure, and EEG recordings were made.

The bursts of sound of military aircraft flyovers and tones produced greater increases in blood pressure than the other sounds. The heart rate responded to noise level (ie: 75 dBA) not type. Overall there was no evidence of habituation to the noise over the three sleep sessions.

This laboratory experiment was able to control the variables and the environment in a way not possible with naturalistic studies (table 1.10). However, there were some weaknesses with this study (table 1.1).

Control of Variables

1. Recording of sounds specifically for research; eg: four noises of Boeing 747 aircraft landing at Sydney Airport recorded from one kilometre away for civilian aircraft landing.

2. Loudspeaker placed in same places in the sleep room.

3. Multiple physiological measures taken during sleep.

4. Choice of volunteers who had worked permanent night shifts for a long time (average of seven years), were in good health without sleep disorders, and had limited alcohol consumption.

5. Participants were asked to keep to habitual caffeine consumption in the 24 hour period before the study to avoid "withdrawal" symptoms if stopped.

6. Three separate testing sessions to gain an average of the effect after one familiarisation sleeping session.

7. Randomisation of the order and level of the noises.

8. Participants were allowed twenty minutes to fall asleep before testing began, and the EEG readings would show that the individual was sleeping.

9. If sleep was disturbed during a 10-minute quiet interval, this was removed from the analysis and an extra quiet interval inserted.

10. The concentration upon eighty minutes within the whole sleep session produced enough data without being too much or too little.

11. Specific measures of physiological changes; eg: blood pressure and heart rate collected for 10 heart beats before the noise ("pre-noise"), ten beats during ("peak noise"), and ten beats after ("post noise").

Table 1.10 - Control of variables and environment afforded a laboratory experiment as used by Carter et al (2002).

Weaknesses

1. Use of recorded sounds rather than real-life ones, which may vary

in intensity.

2. Small number of participants used.

3. Specific sample studied which limits the generalisability of the results to a wider population. They were also mainly young (ae range: 20.1 to 33.7 years).

4. Only one familiarisation sleeping session to get used to the environment and the attached physiological measures.

5. Testing done in first 90 minutes of sleep, which is usually lighter. Sleep involves different types and depths during which the sleeper may respond differently to noise.

6. The study only involved three sleeping sessions.

7. Participants knew what was happening in order to give informed consent, and this could produce "demand characteristics". This is where participants behave as they think the experimenter wants (unconsciously). In this case, loud noises would not disturb them as much as at home because they knew the experimenters were producing them.

Table 1.11 - Key weaknesses with a laboratory study as used by Carter et al (2002).

1.6. WHICH METHOD TO USE

"Since laboratory subjects typically experience a single short period of exposure to high-intensity sound and are aware that their exposure is only temporary, the applicability of these findings to experiences of chronic noise exposure is questionable" (Cohen et al 1980 pp231-2).

Thus Cohen et al (1980) argued that the effect of noise is best studied using laboratory experiments and naturalistic studies together. Laboratory experiments can establish the causal link between noise and behaviour, while naturalistic studies show the relationship in real-life.

Put simply, "The laboratory provides the opportunity for an internally valid investigation, but the generality of laboratory findings is severely restricted. Naturalistic settings provide the opportunity to generalise findings to a greater range of persons and settings but often lack the strict control of the laboratory" (Cohen et al 1980 p232)(table 1.12).

Problems

1. Not equivalent to real-life because the participants know that the noise will last for a limited period only, and they have control over it in the sense of being able to withdraw from the experiment.

2. There is a social contract between the researcher and the participant that suggests to the participant that no harm will come

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to them. In other words, the noise would never be loud to produce hearing damage.

3. Participants in laboratory studies are usually volunteers.

4. In such studies the noise is viewed as appropriate or legitimate in a way that such sound may not be in real-life.

Table 1.12 - Problems with laboratory studies of noise generally

Cohen and Spacapan (1984) felt that the "social context of a laboratory study may serve to lessen the potentially stressing nature of the noise exposure" (p242).

In terms of naturalistic research, most studies could be improved by the inclusion of noise diaries in order to establish the usual everyday levels of noise experienced by individuals, and the use of different noises in the laboratory (Meis 2000). For example, children near airports are presented with aircraft noise, but what about conditions that test the participants while other types of background noise is playing.

Also different schools are used from quiet and noisy environments, and this means different teachers and teaching which could account for differences in school achievement. In Cohen et al's (1973) study of road traffic noise and reading ability based on where the children lived in tower blocks near freeways, the children attended the same school ad classes.

When it comes to the ethical issues related to research, there are slight differences between the methodologies used (table 1.13).

ETHICAL ISSUE	LABORATORY EXPERIMENT	NATURALISTIC STUDY
* Informed consent	Yes	Yes
* Right to withdraw	Yes	Yes
* Deception	Not really unless participants not told about type or level of noise	No
* Distress/Harm	Loud noise may be unpleasant for short term	No because studying noise in real-life and not responsibility of

Table 1.13 - Key ethical issues for research depending on method used.

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2. REDUCING CAR USE AND INCREASING PUBLIC TRANSPORT COMMUTING: TWO STUDIES IN UNDERSTANDING SUCH BEHAVIOUR

2.1. ATTITUDES TO CAR AND PUBLIC TRANSPORT USE

When faced with the serious environmental consequences of certain behaviours, why do individuals continue to perform the destructive behaviour? Joireman et al (2004) concentrated upon one such behaviour - the use of cars when public transport alternatives are available.

This is a case that can be framed as a social dilemma, where individual and collective interests conflict. It is not possible to satisfy both desires - the individual desire to use a car and the collective consequence upon the environment. It is assumed that "pro-selfs" will be concerned with maximising their individual interest and use cars, while "pro-socials", who are concerned with collective benefits, will use public transport.

Research that frames the use of the car in this way produces the following findings (Joireman et al 2004):

- "Pro-socials" prefer public transport more than "pro-selfs";
- Preference for public transport is linked to higher concern with the environment and less concern with convenience ("pro-socials") than the other way around ("pro-selfs");
- Preference for public transport is higher among those who believe it is less environmentally damaging than the car ("pro-socials").

But not all studies support this pattern. One reason may be the role of other variables, like consideration of future consequences (CFC) (ie: short-term or long-term thinking).

Joireman et al (2004) included this variable in their research with commuters in a large city in northwestern USA. Of the six hundred surveys handed out at bus stations/stops and petrol garages, 189 were returned as completed. The survey contained a number of

different measures:

- Social value orientation (SVO) - Individuals were rated as "pro-self" or "pro-social" based upon their response to nine point distribution games. Individuals are offered three choices as to how they would distribute points between themselves and a hypothetical partner in the game.
  For example:

Option A = 480 points to self, 80 points to the other;
Option B = 540 points to self, 280 points to the other;
Option C = 480 points to self, 480 points to the other.

Options A and B are "pro-self" and C is "pro-social". Consistent choices over at least six games led to the classification of "pro-self" or "pro-social". This is a common measure of SVO used in such research.

- Consideration of future consequences (CFC) - The CFC Scale (Strathman et al 1994) contains twelve items (eg: "I consider how things might be in the future and try to influence those things with my day to day behaviour"), and five response options (from "extremely uncharacteristic" to "extremely characteristic").

- Beliefs about the environmental impact of cars - Three items with Likert scale options of 1 (strongly disagree) to 7 (strongly agree). Also a preference for using the car (1) to using public transport (7) was measured. These items were combined to produce a Perceived Environmental Impact Scale.

On the measure of SVO, 110 participants were classed as "pro-social", 42 as "pro-self", and the remainder unclassifiable. SVO was found to be unrelated to commuting preference, but use of public transport was significantly related to high CPC score, and to strong belief that car use harms the environment. A combination of both of these variables produced a mean preference for public transport use of 6 (out of 7) compared to 4 for low scores on both. This difference was significant. So future orientation seems to be more important in use of public transport than being "pro-social".

2.1.1. Evaluation - Positive

1. This study presented the social dilemma as short-term individual interests (commuting by car now) against long-term collective interests (long-term environmental consequences of car use). Many previous studies simply presented the dilemma as individual versus collective

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(social conflict) or as short-term versus long-term (temporal conflict).

2. The study involved real-life decisions rather than being experimental-based and/or hypothetical scenarios.

3. The sample were all commuters in the same city where public transport alternatives to car commuting were available.

2.1.2. Evaluation - Negative

1. There was a response rate of 31.5% for the surveys handed out.

The responses were self-selected and there was no way of knowing how typical of the general population they were. Joireman et al admitted that conscientiousness could be related to CFC, and so the sample was over-representative of high CFC scorers. Also there were only forty-two "pro-self" individuals, and this would be an under-representation. Payment to respondents can reduce these selection biases.

2. Survey measures depend upon honest replies as there was no way to verify the responses. "Social desirability bias" is always a concern with topics where there is great social concern and pressure. In other words, individuals may report concern for the environment, and behave in another way.

In one survey in Britain, for example, two-thirds of people said they only bought low energy light bulbs, but only 10% of light bulbs sold are low energy, according to official figures. "So clearly people are over-claiming here. What it clearly tells us is that people perceive that there is now a sort of cultural norm that the right answer is to say that you are doing these things, that you are acting responsibly in respect of the environment even though they're not" (Andrew Cooper 2007).

Anonymity can reduce this risk to some extent.

3. The SVO measure, though typical of this type of research, was hypothetical and artificial. However, this measure is internally reliable, "free from concerns with social desirability", and "ecological valid" argued Joireman et al.

4. The data were only correlational not causal. In other words, certain behaviours were associated together (in a two-way relationship), but it was not possible to say that one caused the other (figure 2.1).

CAUSATION: A causes B

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A: Strong belief that cars harm environment → B: Strong preference for public transport use

CORRELATION: Two-way relationship between variables, so B could lead to A also

A: Strong belief that cars harm environment ↔ B: Strong preference for public transport use

Figure 2.1 - Difference between causation and correlation.

It is also possible that with a correlation, there is a third variable that mediates the relationship between the other two variables; for example, concern about own and family's health (figure 2.2).

A: Strong belief that cars harm environment → B: Strong preference for public transport use

↓ ↑

C: Concern about own and family's health

Figure 2.2 - Third variable that mediates a correlation.

5. Attitudes and behaviour may not be the same thing because of "structural barriers". For example, individuals with a strong preference for public transport use may have to use their cars to commute because of a lack of available and suitable public transport (eg: timings, destinations, cost).

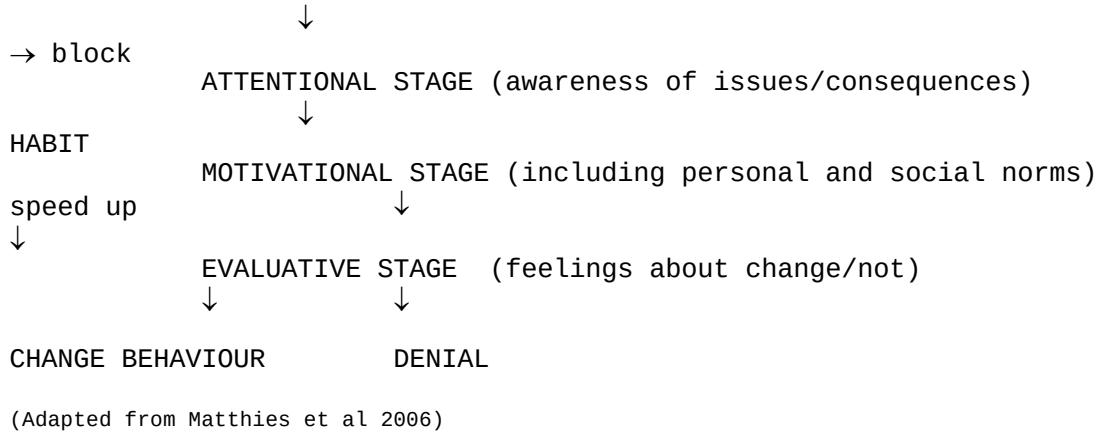
2.2. FIELD EXPERIMENT

If reducing car use is an aim, any programme to do this has to deal with the "car use habit". Schwartz and Howard (1981) proposed a model for changing behaviour which required attention, motivation, and evaluation. But the process of change can be shortcut or blocked by habits (figure 2.3.).

Matthies et al (2006) designed an intervention to reduce car use in Germany which took account of habit.

CAR USE HAS ENVIRONMENTAL IMPACT

Kevin Brewer; 2009; ISBN: 978-1-904542-39-1



(Adapted from Matthies et al 2006)

Figure 2.3 - Schwartz and Howard's (1981) model of behaviour change.

These are known as "strategies to defrost habitualised behaviours" (eg: temporary closure of main road). In this study, it involved temporary free public transport tickets.

In Schwartz and Howard's model, the attention stage could involve trying out alternative modes of travel to the car, and the motivational stage would be a commitment to use public transport for a certain period.

Matthies et al designed a field experiment using the neighbouring towns of Bochum and Dortmund over eight weeks with a follow-up at week 26. Participants were approached by letter and telephone in each town. Individuals were recruited who made a regular journey (at least twice a week), and did not have a public transport season ticket. Only 297 individuals completed the study.

They were divided into four conditions (figure 2.4):

- Commitment to change behaviour with free public transport ticket (n = 130);
- Commitment only (n =61);
- Ticket only (n = 53)
- Control group with neither (n = 53).

The free ticket lasted 14 days and was valid for the regular journeys only. The commitment asked participants to agree to certain statements, like "I commit to change the way I drive to save fuel during the next two weeks", from a list of ten alternatives. One alternative was to try out public transport once or twice during the study.

The strength of car use habit was measured by participants' immediate choice of transport mode in response to five imaginary trips (eg: visiting a friend in a neighbouring city).

CONDITIONS:	Commit/Tkt	Commit	Ticket	Control

Wks 1/2 Baseline	TELEPHONE INTERVIEWS			
Wks 3/4 Phase 1	Ticket	0	Ticket	0
Wks 5/6 Phase 2	Commit	Commit	0	0
Wks 7/8 Post-Treatment	TELEPHONE INTERVIEWS			
Wks 25/26 Follow-up	TELEPHONE INTERVIEWS			

(0 = no intervention)

Figure 2.4 - Design of Matthies et al's experiment.

The free ticket did not alter the general car habit. Overall, though, all interventions produced a small short-term effect to tryout public transport, but free tickets plus commitment worked best in the long run (26 week follow-up). The study showed that incentives and personal commitment combined are required to change behaviour. This is even better if there is a strong personal norm in favour of the desired behaviour.

However, the numbers who tried out public transport were not very high even in the best condition (less than one-fifth) - "the effects we found are rather small, showing once again how difficult it is to change habitual behaviour" (Matthies et al 2006 p103).

2.2.1. Methodological Issues

1. The main problem encountered by this study was in recruiting willing participants who saw the study through (table 2.1).

INHABITANTS OF TOWNS	= 1 million (approx)
Random selection of individuals with good access to public transport	= 6500
Not contacted	= 1890
Reached but unwilling to answer	= 1156
Willing but did not meet criteria	= 2237
Baseline interview	= 1217
Willing participants for experiment	= 578
140 withdrew before study started	
141 dropped out during study	
Completing study	= 297

Table 2.1 - Breakdown of number of participants in study.

There were not equal numbers in each condition, and

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this was partly due to the drop out rates after the study had began: 27% from commitment/ticket condition, 33% from commitment only condition, and 36.9% in each of other two conditions.

In fact, only 38 participants chose a public transport commitment ("I commit to use public transportation at least one/two times during the next two weeks for my regular trips").

2. This was a field experiment which meant that it had the advantages of the control of the experimental method and the real-life situation of a field study. However, the main focus of the study was a short period - two week interventions - and these may not have been typical periods for the participants including unforeseen variables like poor weather conditions which discourage public transport use.

There were also other uncontrolled variables, like the amount of general publicity about car use and the environment, and the individuals themselves reflecting upon the issues because they were part of this study.

3. Participants recorded their travel mode choices in a logbook. There was no way of verifying the accuracy of the information. The logbooks were delivered and collected every four weeks by different trained staff. Regular telephone interviews were performed by different staff each time. This may have been an advantage 9to avoid influences of one member of staff) or a disadvantage (participants feeling no personal connection to the study).

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3. PERSUADING PEOPLE TO BECOME MORE GREEN BY SCARING THEM?

3.1. INTRODUCTION

It seems that everyday there is a new report warning of the consequences of global warming. Undoubtedly changing our behaviour to become more environmentally friendly is necessary, but how should individuals be persuaded?

Many of the messages about the consequences of global warning are scary, whether they mean to be or not, with dire consequences for later this century.

It may seem that fear of the consequences is a good way to motivate individuals to change. The "fear-drive model" saw the reduction of fear as a strong motivator and reinforcer of new behaviour (Dollard and Miller 1950). But the psychological research studies do not necessarily all support this idea.

3.2. CLASSIC RESEARCH EXAMPLES

1. Janis and Feshbach (1953)

This classic research set out to persuade participants about dental hygiene using different levels of fear about tooth decay in the message.

There were three conditions; each seeing a slightly different film about tooth decay, while the control group saw a film about the eye. The main film varied the number of references to the unpleasantness of tooth decay. In the "high fear" condition, there were 71 references to unpleasant effects of tooth decay, compared to 49 references in the "moderate fear" condition, and 18 in the "low fear" condition.

The "high fear" condition produced the greatest immediate attitude change. But, in the longer term, the "low fear" condition produced the most behaviour change (37% showing a change in behaviour compared to 8% for the "high fear" condition).

Creating a small amount of fear allows the

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individual to feel they can control it by doing something. Too much fear produces a feeling of helplessness and behaviour does not change (Brewer 2003).

2. Dabbs and Leventhal (1966)

This research was a similar experiment to above, but it was trying to persuade students to get inoculation for tetanus by using descriptions of the illness.

Students in the "high fear" condition rated their intention to get inoculated as high (average 5.17 out of 7), but only 22% actually did it. Thus the "high fear" message produced an immediate attitude change but not a longer-term behaviour change.

3. Bernadi (1970)

This study investigated attitude change towards forest fire prevention in California using three short films about forest fires (and a control film). The level of fear varied in the films based around the damage caused by forest fires (eg: "high threat" film showed wildfire damage).

Just under 200 high school students living in a high fire-risk area were asked about their attitudes towards forest fire prevention before and after watching one of the films.

Only the "no threat" film (showing forest scenes) produced a significant attitude change towards the statement "Where the countryside or forests are green one need not worry about discarding cigarette butts and used matches on the ground" compared to the control film (non-fire film). But the "mild threat" film (some scenes of fire damage) was most effective in attitude change among students who lived or worked in "wildland" areas.

3.3. RESEARCH REVIEWS

1. Sutton (1982)

This review of 35 studies between 1953 and 1980 found a pattern that fear messages changed behaviour more than no fear, and that higher levels of fear were better than lower levels.

2. Barth and Bengel (2000)

This is a review of studies from 1980 to 1995. Studies have shown increasing attitude change with

increasing fear (eg: crime prevention; Gleicher and Petty 1982) as well as the least attitude change or even attitude change in the opposite direction due to high levels of fear in the message (eg: drinking alcohol and driving; Kohn et al 1982). Other studies have found no relationship between attitude change and fear (eg: fluoridation of water to prevent tooth decay; Baron et al 1994).

3.4. KEY FACTORS IN THE USE OF FEAR IN PERSUASION

1. Presentation of realistic ways to prevent consequences. Unfortunately, many of the warnings of dire consequences suggest that they will happen whatever an individual does now. "If we're just making people more and more scared without building their sense of agency, we've missed half of the equation.. It's called climate porn, climate pornography. It's that we almost enjoy the Armageddon-ness of it.. It's like picking a scab. It's going to be awful" (Solitaire Townsend 2007).

2. Perceived self-efficacy about the recommended action. This is the degree to which individuals feel that they can (and want) to carry out the recommended action.

3. Extreme fear messages produce denial ("it won't happen here" or "it won't happen in my lifetime" or "it's never as bad as they say") particularly if not perceived as self-relevant. It can also produce "reactance", which is a counter-reaction (ie: attitude change in the opposite direct to that desired).

4. The degree of fear of the message interacts with the anxiety level of the individual ("initial level of concern"; McGuire 1968). Highly anxious individuals can feel overwhelmed by fearful messages, and low anxiety individuals may not be motivated by "low fear" messages.

5. Fear appeals can be more effective than erotic, humorous or factual-type messages for some behaviours (eg: using condoms as protection against AIDS; Struckman-Johnson et al 1994).

3.5. MODELS TO EXPLAIN EFFECTS OF FEAR IN PERSUASION

1. Drive-Reduction Model

Originating from the ideas of Behaviourism, drives exist when there is a need (eg: hunger) and the individual is motivated to stop the drive and satisfy the need. The way they do this is reinforced by the reduction

of the drive, and this sets the pattern for future behaviour. The hunger need is satisfied by eating chocolate, and thus, in the future, the individual immediate gets chocolate when hungry, for example.

Dollard and Miller (1950) proposed that fear is similar to a drive, and so needs reducing. Fear-arousing communications produce the drive which is reduced by a change in behaviour. So it is crucial that there is a way for individuals to reduce the fear drive, which then becomes a learned behaviour.

Too many messages about the future disasters do not give individuals that opportunity. Whatever you do will not stop global warming. So there is no behaviour that can reduce the fear drive.

Evaluation

Limited empirical evidence: "Overall, the empirical verification of the model is poor" (Barth and Bengel 2000 p25).

2. Curvilinear Model

Janis and Feshbach (1953) found a greater desirable change in behaviour for the lower levels of fear. One explanation was that strong feelings of fear produce a defence response and the message is not attended to sufficiently. Thus fear-arousing messages lead to non-attention at a certain point. Also aggression towards the speaker (message source) can be a defence reaction.

Overall a curvilinear relationship exists between the fear level and behaviour change in the form of an inverted U shape. Too low fear produces no behaviour change, some fear produces the most, and too much fear leads to no behaviour change. Janis (1967) preferred a "family" of curves rather than a single one as individuals will vary in their "maximum tolerable level of fear" depending upon the topic and the prior attitude of the individual.

McGuire (1968) proposed six stages to persuasion which can be linked here:

Stage 1 - receive message
Stage 2 - process message
Stage 3 - understand message
Stage 4 - acceptance of arguments in message
Stage 5 - retention of message
Stage 6 - behaviour change

Each stage must be passed through in order for an individual to be persuaded. If high fear produces a

defence reaction, it stops this process at the earlier stages, and thus the individual is not persuaded. While low fear does not stop the process.

McGuire also proposed a mathematical equation to explain persuasion:

$$p(I) = p(R) \times p(Y)$$

where:

- p(I) is the probability of being influenced by a persuasion message
- p(R) is the probability of receiving the message (stages 1-3 above)
- p(Y) is the probability of accepting (yielding) the message (stage 4 above) (McGuire 1968 p1143).

Testing this equation produces an inverted U shape relationship for the level of fear because p(R) declines with increasing fear while p(Y) increases with increasing fear for McGuire.

Evaluation

i) There is no prediction of what level of fear will produce a defence reaction (Barth and Bengel 2000).

ii) This model proposes that low and high fear produce the least positive behaviour change, and moderate fear the most.

a) Evidence for (example): Skilbeck et al (1977)

This study found that moderate fear about the effects of weight gain was best for motivation to join a weight reduction programme.

b) Evidence against (example): Leventhal and Niles (1965)

Participants viewed one of four fear-arousing films about road safety with the aim of encouraging car seatbelt use. Positive attitudes increased with increasing length of the film (fear) (ie: positive correlation).

c) Evidence unclear (example): Leventhal and Watts (1966)

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This study measured behaviour change towards giving up smoking by agreeing to an X-ray immediately after the experiment, and reduction of smoking five months later. Increasing fear led to less agreements to X-ray, but greater reduction in smoking.

Overall, Barth and Bengel (2000) felt that there was more evidence not finding a curvilinear relationship between fear and behaviour change. Part of the problem was that studies have measured and operationalised fear in different ways. Sutton (1992) talked of the "myth of the inverted u function" because of the lack of supporting evidence.

3. Parallel Response Model

This model (Leventhal 1970; Leventhal et al 1983) distinguishes between two processes in response to a fear message:

i) Danger control motivation - This is an "objective-control" process where the individual finds a solution to the risk presented in the fear message. This underlies long-term behaviour change;

ii) Fear control motivation - This is a "subjective-emotion" process which seeks to reduce the unpleasant emotions created by the fear message. It tends to produce a short-term reaction.

Though these processes are independent, the degree of fear in the persuasive communication will influence which process dominates. If the level of fear is too high, fear control motivation dominates and the individual concentrates on avoiding the unpleasant emotions rather than making positive behaviour change (danger control motivation). The opposite could be true for low fear messages.

One upshot of this model is the benefit of giving clear advice on how to reduce the risk and this will aid the danger control motivation. Leventhal et al (1965) set up an experiment to improve tetanus vaccination uptake, and varied the degree of fear (based on the consequences of getting tetanus) and the level of concrete advice (eg: where and when to get vaccinated). The latter proved more effective in changing behaviour than the level of fear.

Evaluation

i) Processes of fear control and danger control

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motivation are not "explicitly separated" in experiments (Barth and Bengel 2000).

ii) The model tends to be more theoretical than practical. For example, it does not specify precisely when one type of motivation dominates the other (Barth and Bengel 2000).

iii) The positive conclusion from the model is that fear messages should also include instructions about how to reduce the risks in order to aid danger control motivation.

4. Protection Motivation Theory

This model (Rogers 1975) sees the response to a fear message dependent upon certain variables:

a) Severity of the threat (or perceived severity) - how bad will it be;

b) The likelihood of the event occurring; ie: perceived personal risk or vulnerability. These two variables are the "threat appraisal";

c) The "coping appraisal" which includes the perception of skill to implement recommended changes, perceived effectiveness of the new behaviour, and rewards for change greater than costs and greater than rewards for not changing (reward for maladaptive behaviour; Rippetoe and Rogers 1987).

Some models see individuals as trying to avoid the fear message, but here individuals can accept it (threat appraisal) and not change their behaviour because they perceive the new behaviour as ineffective (coping appraisal), for example.

In terms of research examples, Rogers and Mewborn (1976) varied the three variables above in scenarios to encourage safer driving, and to stop smoking. Perceived effectiveness of new behaviour was key to individual's intention to change.

Applied to the topic of becoming more green - individuals perceive their changes in lifestyle as ineffective or having greater costs for them compared to the benefits of change. In the West, major lifestyle changes are needed which individuals would prefer not to do, particularly if the message is received that climate change is inevitable.

A perceived lack of effectiveness of behaviour changes can lead to blaming others. For example, Crowley (2007) was pessimistic about rich countries changing

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their behaviour because of the dominance of powerful interest groups, particularly in the USA, which only give "lip service" to climate change: "After fifteen years of discussions and agreements on global warming, there is little to show in terms of actual reduced emissions".

Evaluation

i) Plenty of research on the variables in this model, but less on how they are linked (Barth and Bengel 2000). For example, do they work separately, or are they additive (as proposed by Rogers 1983)?

ii) Much of the research for this model has used students (Barth and Bengel 2000). This is not untypical of many psychology experiments, simply because university researchers have easy access to them, but it does limit the generalisability of findings to the wider population.

3.6. CONCLUSIONS

Some models suggest that increasing the level of fear will increase positive changes in behaviour, other models say the opposite, and there is the curvilinear relationship where a moderate amount of fear is beneficial. The important point is that fear alone will not, on the whole, terrify people into changing their behaviour or lifestyle. There are other factors involved including advice on what to do, beliefs about the consequences of changing or not changing, and social norms.

The motivation to change is not necessarily concern for the environment, but can be social status through being seen to do something, like having a solar panel, but on a north facing roof which faces the neighbours. Camilla Cavendish (2007) suggested: "Make it fashionable to be truly green, separate green status from wealth, and you could find that habits change dramatically".

The issues are complex, and so, for example, the short school run in the SUV is not about carbon emissions, but about "the surety of getting their kids to school on time, plus even the safety of those kids" (Tim Jackson 2007). Furthermore, individuals may not change unilaterally because of the "Free Rider" problem (Dawes 1980). This is the fear that others not changing (selfish) take advantage of their altruism.

The problem with climate change is that there is not a direct relationship between a certain behaviour and the consequences that individuals can perceive. If driving a petrol-thirsty car 1 km per day to the shops and back led

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to that individual having their basement flooded once a year, then fear messages would be more effective. The individual could see their personal vulnerability, and the costs and benefits of not changing their behaviour. Unfortunately, it is in the West that individuals drive their cars for short distances, and in the Third World where flooding is the consequence. There is little personal relevance. Fear messages are more effective when there is real personal relevance (White 1992).

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4. THE "MOZART EFFECT": TOO SPECIFIC

4.1. THE "MOZART EFFECT"

The "Mozart effect" (ME) is "the idea that exposure to classical music (especially the music of Mozart) improves intelligence" (Bangerter and Heath 2004 p606).

The original study on the ME (Rauscher et al 1993) [6] found that 36 college students (in a repeated measures design) increased their performance on the spatial reasoning skills [7] of the Stanford-Binet Intelligence Scale (Thorndike et al 1986) by 8-9 points after listening to ten minutes of Mozart's "Sonata for Two Pianos in D Major (K448)" compared to 10 minutes of silence or relaxation instructions (table 4.1). The effect lasted for 10-15 minutes.

Subsequently the phrase "Mozart effect" was coined. This is better seen as the narrow version of the ME (ie: improvements in spatial intelligence by students) There were no benefits for spatial recognition tasks (Rauscher et al 1998).

	MOZART	RELAXATION	SILENCE
Spatial reasoning score (raw score)	57.56	54.61	54.00
Converted to IQ score	119	111	110

(After Rauscher et al 1993)

Table 4.1 - Summary of spatial reasoning scores from Rauscher et al (1993).

The wider version of the ME involves other abilities improved through listening to classical music, like a rat's performance on T-shaped maze learning (Rauscher et al 1998). This study played the music of Mozart ("Sonata for Two Pianos in D Major; K448") or Philip Glass ("Music with Changing Parts"), or white noise twelve hours a day three weeks before birth, and sixty after birth. Table 4.2 summarises the findings.

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[6] This study was cited over eleven times often in newspapers than equivalent scientific reports from the same year (eg: origin of Pluto's peculiar orbit)(Bangerter and Heath 2004).

[7] Spatial ability includes "the ability to manipulate objects in space and time, the ability to visualise varying configurations of a spatial array, the ability to determine spatial orientation with respect to one's body (as in maze running) (Rauscher et al 1998 p427).

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	MOZART	PHILIP GLASS	WHITE NOISE
Mean speed to reach goal box in maze (secs)	34.72	50.11	44.29
Mean number of errors	2.0	2.85	3.35

(After Rauscher et al 1998)

Table 4.2 - Summary of results from Rauscher et al (1998).

Statistical analysis with the parametric unrelated t-test showed significant difference for Mozart against the other two conditions (table 4.3).

Speed to reach goal box in maze	Errors in running maze
Mozart vs Glass t = 2.41; p<0.05*	Mozart vs Glass t = 3.09; p<0.01
Mozart vs white noise t = 2.13; p<0.05	Mozart vs white noise t = 4.78; p<0.01
Glass vs white noise	Glass vs white noise

(* In each case, technically, t(1,58))

Table 4.3 - Summary of t-test results from Rauscher et al (1998).

The widening of the idea includes the emphasis on the benefits for children, babies, and foetuses, and less attention to the original population of students. For example, 80% of articles about the ME found in fifty US newspapers (between 14/10/93 and 13/7/02; total 478 articles) related to the ME and students in 1994, and this had dropped to around 30% by 2002. Articles applying the ME to babies grew from none in 1994 to 50% in 2002 (Bangerter and Heath 2004). However, "There is no scientific research whatsoever linking music and intelligence in infants, and yet, from 1997 onwards, more articles mentioned infants than college students" (Bangerter and Heath 2004 p618).

In a meta-analysis, Chabris (1999) found little effect in 20 studies of the ME. For comparisons of Mozart versus silence, the music produced improvements of 1.4 IQ

points for cognitive enhancement and 2.1 for spatial-temporal processing.

Within popular culture, particularly in the USA, the wider ME has gained in interest. For example, in Florida, a bill was passed in 1998 obliging state-funded day-care centres to play classical music every day. This was based on a study by Rauscher et al (1997) that showed that piano keyboard lessons improved spatial reasoning in pre-school children (and the effect lasted for at least one day; Rauscher et al 1998). This is different, obviously, to just listening to Mozart.

Bangerter and Heath (2004) believed that the ME was an example of a "scientific legend" - a "widespread belief .. that propagates in society, originally arising from scientific study, but that has been transformed to deviate in essential ways from the understanding of scientists" (p608).

4.2. TESTING MOOD AND AROUSAL AND COGNITIVE PERFORMANCE

The ME can be explained by the "arousal and mood hypothesis" (Thompson et al 2001). Music affects individuals in terms of arousal (eg: faster tempo more arousing) and in mood (eg: major keys and happiness). It is the association between particular arousal or mood that can improve cognition, and this does not have to be music, let alone Mozart. For example, participants performed equally well on standard cognitive tasks (three-dimensional rotation, and paper folding and cutting tests [8]) after listening to Mozart or an engaging Stephen King story, if enjoyed what heard (Nantais and Schellenberg 1999).

Other "effects" have been reported for classical composers like Bach (Ivanov and Geake 2003) and Schubert (Nantais and Schellenberg 1999).

4.2.1. Schellenberg et al (2007) Experiment 1

If the arousal and mood hypothesis can explain improvements in cognitive performance after listening to music, the tempo of the music will be more important than the type of music or its presence or absence. Schellenberg et al (2007) played ten minutes of an up-tempo piece of Mozart ("Sonata for Two Pianos in D Major; K448") in a major key or a slow piece in a minor key by Albinoni ("Adagio in G Minor for Organ and Strings") to

[8] The Paper Folding and Cutting (PFC) task involves choosing unfolded paper from five alternatives to match the folded example (Steele et al 1999).

forty-eight Canadian psychology undergraduates at the University of Toronto. Arousal and mood were measured before and after listening to the music.

Cognitive performance was tested by the Symbol Search (matching two patterns from a group of six as quickly as possible) and Letter-Number Sequencing (immediate recall of letters and numbers shown for one second varying from two to eight items)(figure 4.1).

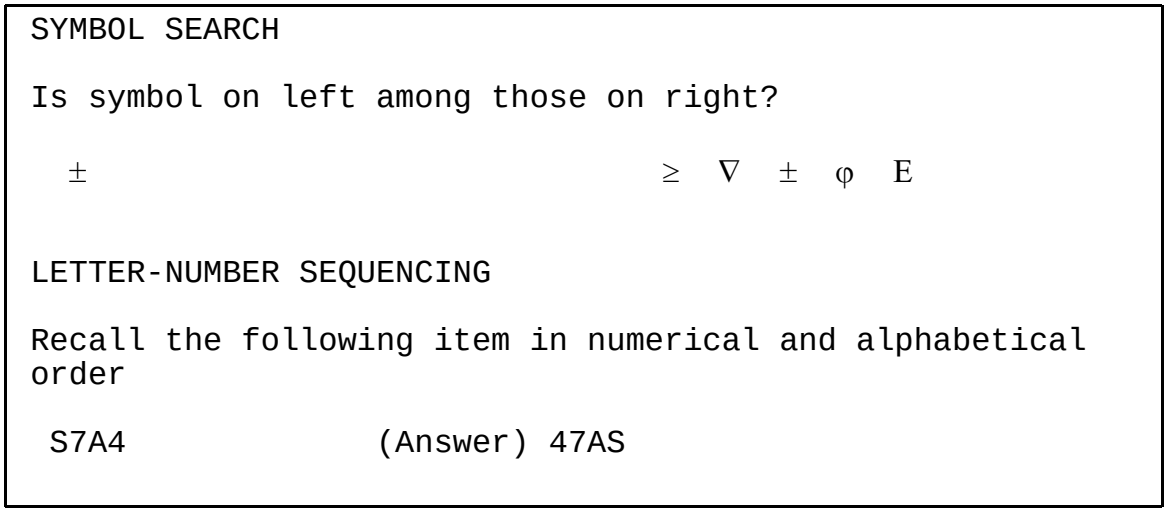

Figure 4.1 - Examples of tasks used to measure cognitive performance.

The experiment used a repeated measures design with one week between each condition. The music order and test order were counterbalanced to give four possibilities (table 4.4).

	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Condition 1	Mozart/ Symbol Search	Albinoni/ Letter-Number Sequencing	Albonini/ Symbol Search	Mozart/ Letter-Number Sequencing
Condition 2	Albinoni/ Letter-Number	Mozart/ Symbol Search	Mozart/ Letter-Number	Albonini/ Symbol Search

Table 4.4 - Four possibilities for counterbalancing in Schellenberg et al (2007).

When participants perform in more than one condition, there is always the problem that their performance in condition 2 will be improved or worse due to condition 1 (known as order effects). So if the order of conditions is always Mozart followed by Albonini, any change in performance after listening to Albonini could

be due to order effects (a confounding variable). By varying the order of conditions for different participants (known as counterbalancing for two conditions or randomisation for more than two conditions), if performance changes in condition 2, for example, through fatigue, it will even out for each piece of music and test.

In fact, the research was affected by a form of order effects. Schellenberg et al found that there was no effect of music listening on arousal in condition 1, but it did vary depending on the composer in condition 2, irrelevant of the order of music. The authors admitted that in condition 1, "Perhaps the unfamiliarity of the testing environment interfered with effects of the music manipulation on arousal in this instance" (p9).

In terms of the effects of music on cognitive performance, participants were only significantly better at the Symbol Search, if condition 2, after listening to Mozart (mean standardised score of 13 versus 10 for Albonini).

Table 4.5 lists the key strengths and weaknesses of this experiment.

STRENGTHS
1. Standardised procedure and controlled environment; eg: participants in sound-attenuating individual booths wearing high-quality stereophonic headphones (SONY MDR-P1) while sitting in front of an iMac computer.
2. Standardised measures used. Cognitive tests were taken from the Wechsler Adult Intelligence Scale (3rd ed) (WAIS-III; Wechsler 1997). Arousal and mood were measured with the Profile of Mood States - Short Form (POMS; McNair et al 1992).
3. Students listened to music and tested alone, whereas many other studies used groups, "where interpersonal dynamics could play a role.. (eg: students rolling their eyes, giggling).." (Schellenberg et al 2007 p15).
WEAKNESSES
1. Problem with order effects.
2. The sample of participants were typical of many laboratory experiments in that they were students. Thus the age range was 18 to 23 years. There was not an equal gender split as 37 were female and eleven male. There was ethnic diversity with 46% not being "European". Schellenberg et al said that this "mirrored the make-up of the local community" in Canada.
3. The participants were not completely volunteers because they received "partial course credit" for an introductory psychology course for participating.

Table 4.5 - Key strengths and weaknesses of Schellenberg

et al's (2007) first experiment.

4.2.2. Schellenberg et al (2007) Experiment 2

In a second experiment, Schellenberg et al (2007) used 39 five year-old Japanese children from Nagasaki (13 boys, 26 girls). This was a repeated measures design where the four conditions were listening to Mozart or Albinoni as in experiment 1 (but for one hour over lunch), listening to familiar children's songs or singing these songs. The cognitive ability being tested was creativity as measured by drawing. Eighteen female undergraduate volunteers rated the baseline drawing and the one after the experimental condition for creativity, energy, and technical proficiency.

This experiment involved three comparisons - classical versus familiar music, listening to fast-major key versus slow-minor key classical music, and singing versus listening to familiar music.

Children's drawing times significantly increased after listening and singing familiar songs, as did all the ratings of the drawings. There was a small advantage of Mozart (uptempo) over Albinoni (slow tempo) in certain ratings. Overall, age-appropriate music seemed to be more effective.

This second study was a field experiment compared to the laboratory experiment of the first one. There are strengths and weaknesses to performing an experiment in the participants' normal environment rather than taking them out of it in the laboratory (table 4.6).

STRENGTHS

1. The children were studied while in their natural environment of the kindergarten.

2. The music was played on a portable CD player, and the singing with the teacher on the piano. These were normal situations for the children.

3. By measuring creativity through drawings, again this did not introduce unfamiliar aspects to the children.

4. After each experimental condition, a subset of children was randomly selected to draw a second picture.

5. The raters were trained, and they were asked to give a comparison score between the baseline and later drawings.

6. The participants were not from the USA as so many studies originate from there. For example, 94% of studies quoted in one social psychology textbook were from North America (Smith and Bond 1993).

WEAKNESSES

1. There was less control than a laboratory experiment because the children were together eating lunch, and not listening to the music possibly (ie: unfocused), or influenced by the other children. While singing together was a focused activity.

2. Arousal and mood were not measured, and these were assumed from observing the children.

3. The rating of drawings by the students produced only ordinal data. This means that the scale was not as objective as time (interval/ratio data).

4. The classical music conditions were not counterbalanced because of technical problems in playing different music at lunch-time to different groups of children.

5. The conditions were not completely identical: one class sang two familiar songs for 20 minutes, while another class heard familiar songs for one hour during lunch-time and then sang two familiar songs.

6. The classical music, of Western origin, may have been an unfamiliar style of music for the Japanese children. However, the Japanese children's songs used were "all in Western major keys with a regular metrical structure" (Schellenberg et al 2007 p11).

Table 4.6 - Strengths and weaknesses of the field experiment used in Schellenberg et al's (2007) second study.

4.3. CONCLUSIONS

Schellenberg et al believed that their work refuted the ME: "there is no merit to the claim of a link between listening to music composed by Mozart to the exclusion of music by other composers, and spatial-temporal abilities to the exclusion of other cognitive abilities.. The ME is simply one example of the many ways that emotional state influences cognitive processing (Schellenberg et al 2007 p16).

Rauscher and Shaw (1998) suggested some methodological issues to consider that may account for differences in findings of the ME between studies:

- Experimental design - eg: use of baseline measure of behaviour. Rauscher et al (1993) did not include one because they were concerned about practice effects when the behaviour measured after the music. In other words, performance would naturally improve doing the test a second time irrelevant of the music. Rauscher and Shaw argued that there must be an interval between the baseline measure and the music to avoid this.

- Validity of test for measuring cognitive ability.
- Participant variables like age, musical training, preference for music, and aptitude for task.

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5. THE EFFECT OF THE NATURAL ENVIRONMENT ON CHILDREN'S COGNITIVE FUNCTIONING: DIRECT AND INDIRECT EVIDENCE

5.1. INTRODUCTION

The environment where people live has an effect on them. The impact of the environment upon behaviour has been highlighted in negative terms:

> As buildings, streets, or even entire districts are allowed to become dirty, litter strewn and covered in graffiti, this gives rise to the perception that since no one else really cares about this area, "why should I?". This feeling encourages minor anti-social behaviour, which eventually becomes the norm, leading to ever worsening behaviour and to minor crimes that in turn lead to ever more serious offences and a gradual deterioration of the whole area (Broadhurst et al 2008 p11).

The general housing quality is known to have an effect upon children's psychological and cognitive functioning (eg: inability to concentrate, depression, feelings of hopelessness in Northern Ireland study; Blackman et al 1989).

However, there is less research on the consequences of living in or near a natural environment for children. So it is necessary to use both direct and indirect evidence to find out about the effect. Direct evidence involves actually studying children's cognitive functioning, and indirect evidence includes findings from other studies that can throw light on the topic (table 5.1).

5.2. INDIRECT EVIDENCE

5.2.1. Urban Living

Indirect benefits about the benefits of the natural environment can be derived from studies of children

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	DIRECT EVIDENCE	INDIRECT EVIDENCE
ADVANTAGES	1. Actually study group of interest (ie: children). 2. Actually test ability of interest (ie: cognitive functioning).	1. Topic may not be easy to study directly (eg: how to measure "naturalness" in valid way). 2. Other studies produce findings that can be generalised to area of
DISADVANTAGES	1. Some topics may be very expensive to directly study. 2. Problems in finding participants and designing the research	1. Care has to be taken in extrapolating from one group to another (eg: college students to young children). 2. Have no control over

Table 5.1 - Advantages and disadvantages of using direct and indirect evidence to answer research questions.

living in urban areas, like high-rise blocks. A number of studies showed that children in high-rise blocks have more behavioural problems, for example, as well as differences in play behaviour (Wells 2000).

5.2.2. Studies of Adults' Cognitive Functioning

Indirect evidence about the effect of the natural environment on children can come from studies of adults, like experiments by Hartig et al (1991). The first study compared three groups of backpackers on a proofreading task (measure of concentration). One group of participants were tested after returning from a wilderness backpacking holiday, the next after an urban holiday, and a control group of no holiday. The first group showed the best improvement from the baseline.

In a second similar study, participants who walked in the country did better on the proofreading test than those who walked in the city or those who just relaxed.

There are a number of studies comparing adults in different settings who have a natural view from their windows and those that don't (table 5.2).

5.3. DIRECT EVIDENCE

Wells (2000) performed a longitudinal study that compared the cognitive abilities of seventeen children (8 girls, 9 boys) from US low income families who lived in "poor" housing and then moved to better housing. The ages

STUDY	FINDINGS ABOUT A NATURAL VIEW
Verberder and Reuman (1987)	Patients in hospital recover faster from surgery
Tennessen and Cimprich (1995)	College students had better attentional abilities (based on dormitory room view)
Moore (1981)	Prisoners make fewer visits to infirmary

Table 5.2. - Three examples of studies with adults showing benefits of a natural view from their windows.

ranged from 7-12 years with eight years old as most common. Most of the children were African-American (65%; 6 girls, 5 boys), and overall thirteen lived in female-headed single-parent households.

A naturalness scale was devised based on ten items about the view of the natural and the built environment from windows in each room. For example, "What is the view from the living room?" 0 = none, 1 = no natural, 2= less than half natural, 3 = more than half natural" (p785). A higher score indicated a more natural environment (maximum = 42).

The children's cognitive functioning was measured by the 46-item parent-answered Attention Deficit Disorders Evaluation Scale (ADDES)(McCarney 1995). Five responses option, varying from "does not engage in the behaviour" (0) to "engages in behaviour one or several times per hour" (4), were offered for items like "Is easily angerd, annoyed, or upset" and "Starts but does not complete homework". The ADDES was used as a measure of the children's ability to focus their attention (known as "directed attentional capacity"; DAC).

The families were visited in the "poor" housing (pre-move) and one year later in the new housing (post-move). Both sets of interviews took place in summer, so no seasonal differences in vegetation to influence the naturalness scale when completed by a research assistant.

It was found that children who experienced the most improvement in naturalness between pre-move and post-move housing showed the most positive change in DAC. "These findings suggest that the power of nature is indeed profound" (Wells 2000 p790).

Table 5.3 lists the strength and weaknesses of this study.

STRENGTHS

1. Trained raters scored the naturalness scale for pre-move and post-move housing.

2. The mothers' rated their children on the ADDES which has established validity and reliability.

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3. It is a longitudinal study which compares the same children at two points in time - pre and post change.

4. It is a prospective study that collects data at the baseline and follows the progress of the participants. The alternative (retrospective) would ask the mothers to think back to pre-move which has problems with recall accuracy.

5. Used an opportunity sample of families in a programme that helped them move to better housing.

6. Concentrated on specific children (low-income families) and particular abilities (DAC). Many studies used a larger sample, but can be too wide in their focus.

WEAKNESSES

1. The children's cognitive functioning was not tested.

2. The sample which quite specific which limits the generalisability of the results.

3. Only the home environment was rated for naturalness, not the school environment where children spend many hours per day as well.

4. The study only rated the views of nature, not the noise or pollution levels.

5. How to interpret a middle score on the naturalness scale. It could be that one part of the house faced nature and the other a built environment, or simply average scores on all items.

6. It was not an experiment because the independent variable (level of naturalness of environment where lived) was not manipulated by the researcher nor was there a control group (who did not move).

Table 5.3 - Strengths and weaknesses of the longitudinal study by Wells (2000).

5.4. CONCLUSIONS

Overall, "a child living in a place with more nature, with more restorative resources is likely to benefit with respect to his or her cognitive functioning or attentional capacity" (Wells 2000 p782).

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